CLAIMS

What is claimed is:

1. A method of automatically converting a web of a thin patterned catalyst-coated membrane to separate membrane sheets for fuel cell assembly, a first side of the membrane web coated with an anode catalyst and a second side of the membrane web coated with a cathode catalyst, the method comprising:

transporting, with use of a movable vacuum, an end portion of the membrane web from a first location to a second location;

securing, with use of respective first and second vacuums at the first and second locations and after removal of the movable vacuum, the end portion of the membrane web at the first and second locations;

cutting the membrane web within a gap defined between a single catalyst pattern of the membrane web end portion and an adjacent catalyst pattern to produce a membrane sheet; and

positioning the membrane sheet to a desired orientation to facilitate subsequent processing of the membrane sheet.

2. The method of claim 1, wherein the membrane is less than about two thousandths of an inch in thickness.

3. The method of claim 1, further comprising:

securing, with use of the first vacuum, the end portion of the membrane web at the first location;

moving the movable vacuum to the first location; and

activating the movable vacuum and removing the first vacuum to facilitate transport of the end portion of the membrane web by use of the movable vacuum.

4. The method of claim 1, further comprising detecting advancement of the single catalyst pattern to the second location.

5. The method of claim 4, wherein advancement of the single catalyst pattern is detected optically.

6. The method of claim 4, wherein advancement of the single catalyst pattern is detected by detecting the gap defined between the single catalyst pattern and the adjacent catalyst pattern.

7. The method of claim 1, wherein positioning the membrane sheet comprises optically detecting that the membrane sheet is positioned to the desired orientation.

8. The method of claim 1, wherein positioning the membrane sheet comprises detecting, via camera detection, that the membrane sheet is positioned to the desired orientation.

9. The method of claim 1, wherein positioning the membrane sheet comprises moving the membrane sheet axially with respect to an x-axis and a y-axis, and rotationally about a z-axis to position the membrane sheet to the desired orientation.

10. The method of claim 9, further comprising optically detecting that the membrane sheet is positioned to the desired x-axis, y-axis, and rotational orientation.

11. The method of claim 9, further comprising detecting, via camera detection, that the membrane sheet is positioned to the desired x-axis, y-axis, and rotational orientation.

12. The method of claim 1, further comprising automatically inspecting the membrane web to detect completeness of membrane patterns.

13. The method of claim 12, wherein automatically inspecting the membrane web comprises optically inspecting the membrane web.

14. The method of claim 12, wherein automatically inspecting the membrane web comprises inspecting the membrane web via camera inspection.

15. The method of claim 1, further comprising automatically inspecting one or both of a size and a quality of membrane patterns.

16. The method of claim 15, wherein automatically inspecting the membrane patterns comprises optically inspecting the membrane patterns.

17. The method of claim 15, wherein automatically inspecting the membrane patterns comprises inspecting the membrane patterns via camera inspection.

18. An apparatus for automatically converting a web of a thin patterned catalyst-coated membrane to separate membrane sheets for fuel cell assembly, a first side of the membrane web coated with an anode catalyst and a second side of the membrane web coated with a cathode catalyst, a web handling module presenting an end portion of the membrane web, the apparatus comprising:

a staging station comprising a first vacuum and a gap detector, the gap detector detecting a gap between catalyst patterns of the membrane web, the staging station receiving the end portion of the membrane web;

a positioning station comprising a positioning table and a second vacuum, the positioning table controllable to move axially and rotationally;

a cutter;

a vision system provided at the positioning station, the vision system detecting an orientation of a membrane sheet cut from the membrane web;

a robot comprising a vacuum chuck, the robot moveable between at least the staging station and the positioning station; and

a controller, the controller programmed to cause the robot to transport, with use of a vacuum at the vacuum chuck, the end portion of the membrane web from the staging station to the positioning table, to selectively actuate and deactivate the first and second vacuums and the vacuum chuck vacuum when causing the cutter to cut the membrane web within the gap between catalyst patterns, and to control movement of the positioning table so that the membrane sheet is moved to a desired orientation to facilitate subsequent processing of the membrane sheet.

19. The apparatus of claim 18, wherein the membrane is less than about two thousandths of an inch in thickness.

20. The apparatus of claim 18, wherein the controller is programmed to automatically convert the membrane web to a plurality of the separate membrane sheets.

21. The apparatus of claim 18, wherein the controller actuates the first vacuum to secure the end portion of the membrane web at the staging station, causes the robot to move to the staging station, and actuates the vacuum chuck and deactivates the first vacuum to facilitate transport of the end portion of the membrane web from the staging station to the positioning table by use the vacuum chuck.

22. The apparatus of claim 18, wherein the controller, in response to the gap detector detecting advancement of a single catalyst pattern of the membrane web to the positioning table, actuating the first and second vacuums and deactivating the vacuum chuck vacuum to stabilize the membrane web and causing the cutter to cut the membrane web within the gap between the single catalyst pattern and an adjacent catalyst pattern to produce a membrane sheet.

23. The apparatus of claim 18, wherein the gap detector comprises an optical detector that optically detects advancement of a single catalyst pattern of the membrane web to the second location.

24. The apparatus of claim 18, wherein the gap detector comprises a photo-eye that detects advancement of a single catalyst pattern of the membrane web to the second location.

25. The apparatus of claim 18, wherein the vision system comprises one or more cameras.

26. The apparatus of claim 18, wherein the vision system comprises a processor that determines axial orientation of the membrane sheet with respect to an x-axis, y-axis, and z-axis, the processor communicatively coupled to the controller to control movement of the positioning table so that the membrane sheet is moved to the desired orientation.

27. The apparatus of claim 18, wherein the robot comprises a servomotor drive system for moving the robot axially with respect to an x-axis, y-axis, and z-axis.

28. The apparatus of claim 18, wherein the robot comprises at least one pneumatic motivator for moving the robot axially with respect to one of an x-axis, y-axis, and z-axis.

29. The apparatus of claim 18, wherein the robot comprises:

a first servomotor for moving the robot axially with respect to an x-axis;

a second servomotor for moving the robot axially with respect to a z-axis; and

a pneumatic motivator for moving the robot axially with respect to a y-axis.

30. The apparatus of claim 18, wherein the staging station is stationary.

31. The apparatus of claim 18, wherein the positioning system comprises a servomotor drive system for moving the positioning table axially with respect to an x-axis and y-axis, and rotationally about a z-axis.

32. The apparatus of claim 18, further comprising an optical detector for inspecting the membrane web to detect completeness of the catalyst patterns.

33. The apparatus of claim 18, further comprising an inspection camera for inspecting the membrane web to detect completeness of the catalyst patterns.

34. The apparatus of claim 18, further comprising an optical detector for inspecting one or both of a size and a quality of the catalyst patterns.

35. The apparatus of claim 18, further comprising an inspection camera for inspecting one or both of a size and a quality of the catalyst patterns.